



REEXAMINATION CERTIFICATE (2610th)

United States Patent [19]

[11] B1 4,373,527

Fischell

[45] Certificate Issued Jun. 27, 1995

- [54] IMPLANTABLE PROGRAMMABLE MEDICATION INFUSION SYSTEM**
- [75] Inventor: Robert E. Fischell, Silver Spring, Md.**
- [73] Assignee: The John Hopkins University, Baltimore, Md.**

- | | | | |
|-----------|---------|-----------------------|---------|
| 4,191,181 | 3/1980 | Franetzki et al. | 604/151 |
| 4,223,678 | 9/1980 | Langer et al. | 607/5 |
| 4,232,679 | 11/1980 | Schulman | 607/33 |
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| 4,282,872 | 8/1981 | Franetzki et al. | 604/67 |
| 4,674,515 | 6/1987 | Andou et al. | 128/4 X |
| 4,732,156 | 3/1988 | Nakamura | 128/4 X |

OTHER PUBLICATIONS

"For Diabetics: An electronic Pancreas," Spencer, IEEE Spectrum, Jun., 1978 pp. 38-42.

Primary Examiner—Francis Jaworski

[57] **ABSTRACT**

An implantable programmable medication infusion system comprises an implantable portion (2) having a medication reservoir (10) at below body pressure and isolated at its input from the body in which it is implanted by an antechamber (8) the pressure integrity of which is checked before filling the medication reservoir (10). Safety features include a leak detector (35), inlet and outlet valves (14 and 212) used with flow impeding filters (12 and 218), and a maximum allowable pressure in a pulsatile bellows pump (202) all of which prevent undesired infusion of medication. Medication flow from the pulsatile bellows pump (202) is in response to programming commands from a drug programming system (1) and processed in an electronics section (30) which uses the commands to program memory units (320 and 322) and to request pulses of medication. Hardwired limit controls (324 and 326) prevent excessive dosage requests from reaching the pulsatile bellows pump (202). For patient convenience and safety, the memory units (320 and 322) are programmed with running integral limits. A record of medication dispensing can be communicated to a physician by means of a telemetry transmitter (336) which sends signals by telemetry to the communications head (300) which information is displayed on the drug programming unit (3).

Reexamination Request:

No. 90/003,119, Jul. 6, 1993

Reexamination Certificate for:

Patent No.: 4,373,527
Issued: Feb. 15, 1983
Appl. No.: 34,155
Filed: Apr. 27, 1979

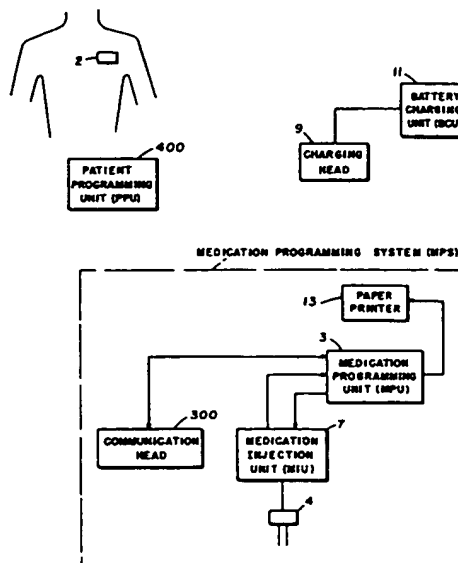
Certificate of Correction issued May 8, 1984.

- [51] **Int. Cl.**⁶ A61M 5/00
[52] **U.S. Cl.** 604/891.1; 128/903;
128/DIG. 12; 128/DIG. 13; 604/151
[58] **Field of Search** 604/891.1, 151;
128/903, DIG. 12, DIG. 13

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REEXAMINATION CERTIFICATE ISSUED UNDER 35 U.S.C. 307

THE PATENT IS HEREBY AMENDED AS
INDICATED BELOW.

Matter enclosed in heavy brackets **[]** appeared in the patent, but has been deleted and is no longer a part of the patent; matter printed in italics indicates additions made to the patent.

AS A RESULT OF REEXAMINATION, IT HAS
BEEN DETERMINED THAT:

The patentability of claims 1-327 and 433-642 is confirmed.

Claims 328-332, 338, 349, 354, 362-371, 375-376, 424-425 and 431 are cancelled.

Claims 333, 339, 348, 350, 351, 360, 361, 372, 373, 377, 378, 380, 384, 388, 403, 426, 428 and 432 are determined to be patentable as amended.

Claims 334-337, 340-347, 352-353, 355-359, 374, 379, 381-383, 385-387, 389-402, 404-423, 427 and 429-430 dependent on an amended claim, are determined to be patentable.

New claim 643 is added and determined to be patentable.

333. *A programmable infusion system for providing medication to a living body of a patient comprising: an infusion apparatus for implantation in said living body, said apparatus including a medication reservoir for storing selected medication, means for infusing said selected medication stored in said medication reservoir into said living body, said infusion means having an infusion rate variable upon command, command receiver means coupled to said infusion means for receiving command signals, means for inhibiting said infusion means from infusing said selected medication if a preselected medication infusion rate is exceeded, said inhibiting means being operably coupled to said infusion means, command source means external to said living body for transmitting said command signals to be received by said command receiver means, wherein said preselected medication infusion rate comprises a remotely selectable rate and a fixed rate, said remotely selectable rate being limited by said fixed rate, [A programmable infusion system in accordance with claim 332, wherein said inhibiting means comprises:] at least one programmable rate memory unit coupled to said command receiver means, each of said at least one programmable rate memory units for receiving and storing an infusion rate input command corresponding to said remotely selectable rate; at least one limit control unit, each of said at least one limit control units providing a fixed rate limit; and means for comparing each of said infusion rate input commands to a corresponding said fixed rate limit,*

infusion of said medication at a rate exceeding said fixed rate limit being inhibited.

339. *A programmable infusion system for providing medication to a living body of a patient comprising:*

5 *an infusion apparatus for implantation in said living body, said apparatus including a medication reservoir for storing selected medication,*

10 *means for infusion said selected medication stored in said medication reservoir into said living body, said infusion means having an infusion rate variable upon command,*

command receiver means coupled to said infusion means for receiving command signals,

15 *means for inhibiting said infusion means from infusing said selected medication if a preselected medication infusion rate is exceeded, said inhibiting means being operably coupled to said infusion means,*

command source means external to said living body for transmitting said command signals to be received by said command receiver means and, [A programmable infusion system in accordance with claim 328,]

wherein said infusion means includes a pump means which executes in pulses, said inhibiting means comprising a programmable memory rate unit coupled to said command receiver for storing initially a dose limit number corresponding to a first maximum number of infusion pulses preselected as allowable during a first shifting time window of a predetermined length, pulse quantities being subtracted from said number stored in said programmable memory rate unit as infusion pulses are executed by said infusion means, pulse quantities being added to said stored number as time elapses such that said number does not exceed said first maximum number, said subtraction and addition being accomplished in running integral fashion, said inhibiting means not permitting pulsing of said pump means at a rate in excess of the rate represented by said dose limit number stored in said programmable memory rate unit.

348. *A programmable infusion system for providing medication to a living body of a patient comprising:*

an infusion apparatus for implantation in said living body, said apparatus including a medication reservoir for storing selected medication,

means for infusing said selected medication stored in said medication reservoir into said living body, said infusion means having an infusion rate variable upon command,

command receiver means coupled to said infusion means for receiving command signals,

means for inhibiting said infusion means from infusing said selected medication if a preselected medication infusion rate is exceeded, said inhibiting means being operably coupled to said infusion means,

command source means external to said living body for transmitting said command signals to be received by said command receiver means, and [A programmable infusion system in accordance with claim 328, further comprising:]

means for telemetering operational information pertaining to said infusion apparatus out of said living body, said operational information including information pertaining to the functions of said inhibiting means, and means for receiving said telemetered operational information external to said living body.

350. A programmable infusion system for providing medication to a living body of a patient comprising:
 an infusion apparatus for implantation in said living body, said apparatus including a medication reservoir for storing selected medication,
 means for infusing said selected medication stored in said medication reservoir into said living body, said infusion means having an infusion rate variable upon command,
 command receiver means coupled to said infusion means for receiving command signals,
 means for inhibiting said infusion means from infusing said selected medication if a preselected medication infusion rate is exceeded, said inhibiting means being operably coupled to said infusion means,
 command source means external to said living body for transmitting said command signals to be received by said command receiver means, and [A programmable infusion system in accordance with claim 328, further comprising:]
 means for telemetering operational information pertaining to said infusion apparatus out of said living body, and means for receiving said telemetered operational information external to said living body, wherein said command source and said telemetry receiving means are embodied in a patient programming unit external to said living body, said patient programming unit having a plurality of operational medication dose inputs each corresponding to a medication infusion rate selectable and requestable by the patient, said patient programming unit for selectively transmitting a command signal corresponding to a selected one of said medication dose inputs.

351. A programmable infusion system in accordance with [claim] claims 350 or 643, wherein said infusion apparatus further comprises electronic control means coupled to said infusion means and said command receiver means, said electronic control means including means for maintaining a history of the infusion rate at which said infusion means has operated, said electronic control means including means for precluding the infusion of said selected medication by said infusion means if said rate requested by said patient programming unit exceeds a predetermined safe medication infusion rate based on said maintained history.

360. A programmable infusion system for providing medication to a living body of a patient comprising:
 an infusion apparatus for implantation in said living body, said apparatus including a medication reservoir for storing selected medication,
 means for infusing said selected medication stored in said medication reservoir into said living body, said infusion means having an infusion rate variable upon command,
 command receiver means coupled to said infusion means for receiving command signals,
 means for inhibiting said infusion means from infusing said selected medication if a preselected medication infusion rate is exceeded, said inhibiting means being operably coupled to said infusion means,
 command source means external to said living body for transmitting said command signals to be received by said command receiver means,
 means for selectively supplying power to said command receiver means, said supply means being coupled to an external power source, said supply means being external to said living body, said infusion means being

powered by an implanted power source, and [A programmable infusion system in accordance with claim 354, further comprising] means for telemetering operational information pertaining to said infusion apparatus out of said living body, and means for receiving said telemetered operational information external to said living body, said telemetry means also being supplied power by said supply means.

361. A programmable infusion system for providing medication to a living body of a patient comprising:
 an infusion apparatus for implantation in said living body, said apparatus including a medication reservoir for storing selected medication,
 means for infusing said selected medication stored in said medication reservoir into said living body, said infusion means having an infusion rate variable upon command,
 command receiver means coupled to said infusion means for receiving command signals,
 means for inhibiting said infusion means from infusing said selected medication if a preselected medication infusion rate is exceeded, said inhibiting means being operably coupled to said infusion means,
 command source means external to said living body for transmitting said command signals to be received by said command receiver means,
 means for selectively supplying power to said command receiver means, said supply means being coupled to an external power source, said supply means being external to said living body, said infusion means being powered by an implanted power source, and [A programmable infusion system in accordance with claim 354, further comprising] means for selectively recharging said implanted power source, said recharging means being powered by said supply means.

372. A programmable infusion system for providing medication to a living body of a patient comprising:
 an infusion apparatus for implantation in said living body, said apparatus including a medication reservoir for storing selected medication,
 means for infusing said selected medication stored in said medication reservoir into said living body, said infusion means having an infusion rate variable upon command,
 command receiver means coupled to said infusion means for receiving command signals,
 means for inhibiting said infusion means from infusing said selected medication if a preselected medication infusion rate is exceeded, said inhibiting means being operably coupled to said infusion means,
 command source means external to said living body for transmitting said command signals to be received by said command receiver means,
 wherein said infusion means comprises a fluid handling mechanism for delivering said selected medication, said operational information including information about the operation of said fluid handling mechanism, wherein said fluid handling mechanism comprises means for pumping said selected medication, wherein said pump means comprises variable volume means for storing said selected medication within said pump means, an increase in volume of said variable volume means permitting drawing of said selected medication into said pump means, decrease in volume of said variable volume means permitting expulsion of said selected medication from said pump means,

wherein said variable volume means comprises at least one flexible wall, movement of said at least one flexible wall varying the volume of said variable volume means, and means for moving said at least one flexible wall,

spring means for urging said at least one flexible wall in a manner which decreases the volume of said variable volume means, the magnitude of the force applied to and stored by said spring means increasing as the volume of said variable volume means increases due to the displacement of said at least one flexible wall thereof by said moving means,

wherein said at least one flexible wall comprises a bellows assembly having mounted on one end thereof a plate, the other end of said bellows assembly being in communication with said selected medication, the walls of said bellows assembly serving as said spring means,

wherein said plate has a surface in contact with said selected medication when drawn into said variable volume means, and [A programmable infusion system in accordance with claim 371,]

wherein said bellows assembly is inhibited from moving said plate when the pressure (p) in said variable volume means exceeds the spring force (F) of said bellows assembly divided by the wetted area (A) of said surface of said plate in contact with said selected medication, that is when $p > F/A$.

373. A programmable infusion system for providing medication to a living body of a patient comprising:

an infusion apparatus for implanting in said living body, said apparatus including a medication reservoir for storing selected medication,

means for infusing said selected medication stored in said medication reservoir into said living body, said infusion means having an infusion rate variable upon command,

command receiver means coupled to said infusion means for receiving command signals,

means for inhibiting said infusion means from infusing said selected medication if a preselected medication infusion rate is exceeded, said inhibiting means being operably coupled to said infusion means,

command source means external to said living body for transmitting said command signals to be received by said command receiver means,

wherein said infusion means comprises a fluid handling mechanism for delivering said selected medication, said operational information including information about the operation of said fluid handling mechanism, wherein said fluid handling mechanism comprises means for pumping said selected medication,

wherein said pump means comprises variable volume means for storing said selected medication within said pump means, an increase in volume of said variable volume means permitting drawing of said selected medication into said pump means, decrease in volume of said variable volume means permitting expulsion of said selected medication from said pump means,

wherein said variable volume means comprises at least one flexible wall, movement of said at least one flexible wall varying the volume of said variable volume means, and means for moving said at least one flexible wall,

spring means for urging said at least one flexible wall in a manner which decreases the volume of said variable volume means, the magnitude of the force applied to and stored by said spring means increasing as the

volume of said variable volume means increases due to the displacement of said at least one flexible wall thereof by said moving means,

wherein said at least one flexible wall comprises a bellows assembly having mounted on one end thereof a plate, the other end of said bellows assembly being in communication with said selected medication, the walls of said bellows assembly serving as said spring means, and [A programmable infusion system in accordance with claim 370,]

wherein said plate is magnetizable, said moving means comprising a coil disposed proximate to said plate, said coil selectively radiating a pulsing magnetic field, pulsing of said coil causing said plate to be moved.

377. A programmable infusion system for providing medication to a living body of a patient comprising:

an infusion apparatus for implantation in said living body, said apparatus including a medication reservoir for storing selected medication,

means for infusing said selected medication stored in said medication reservoir into said living body, said infusion means having an infusion rate variable upon command,

command receiver means coupled to said infusion means for receiving command signals,

means for inhibiting said infusion means from infusing said selected medication if a preselected medication infusion rate is exceeded, said inhibiting means being operably coupled to said infusion means,

command source means external to said living body for transmitting said command signals to be received by said command receiver means,

wherein said infusion means comprises a fluid handling mechanism for delivering said selected medication, said operational information including information about the operation of said fluid handling mechanism, wherein said fluid handling mechanism comprises means for pumping said selected medication,

wherein said pump means comprises variable volume means for storing said selected medication within said pump means, an increase in volume of said variable volume means permitting drawing of said selected medication into said pump means, decrease in volume of said variable volume means permitting expulsion of said selected medication from said pump means,

wherein said infusion means further comprises:

an interface pressure valve through which said selected medication enters said variable volume means from said medication reservoir, said interface pressure valve being normally closed;

an outlet chamber which is in communication with said living body; and

an outlet pressure valve located between said variable volume means and said outlet chamber, said outlet pressure valve being normally closed, an increase in volume of said variable volume means causing said interface pressure valve to open and medication to enter said variable means, a decrease in volume of said variable volume means causing said outlet pressure valve to open and said interface pressure valve to close, so as to permit medication to enter said outlet chamber as a pressure pulse, and [A programmable infusion system in accordance with claim 376,]

wherein said outlet chamber comprises an elastic wall having a fluidic capacitive effect on the flow of said selected medication and a filter element through

which liquid flow to the said living body is resisted, said elastic wall and said filter comprising a fluid resistance-capacitance arrangement with respect to said flow of said selected medication from said outlet chamber into said living body.

378. A programmable infusion system for providing medication to a living body of a patient comprising:
 an infusion apparatus for implantation in said living body, said apparatus including a medication reservoir for storing selected medication,
 means for infusing said selected medication stored in said medication reservoir into said living body, said infusion means having an infusion rate variable upon command,
 command receiver means coupled to said infusion means for receiving command signals,
 means for inhibiting said infusion means from infusing said selected medication if a preselected medication infusion rate is exceeded, said inhibiting means being operably coupled to said infusion means,
 command source means external to said living body for transmitting said command signals to be received by said command receiver means,
 wherein said infusion means comprises a fluid handling mechanism for delivering said selected medication, said operational information including information about the operation of said fluid handling mechanism, wherein said fluid handling mechanism comprises means for pumping said selected medication,
 wherein said pump means further comprises pressure limiting means for controlling the amount of medication pumped by said pump means,
 wherein said pump means operates in a pulsatile mode, wherein said pump means pumps a fixed volume of said selected medication each time said pump means is pulsed, and [A programmable infusion system in accordance with claim 366, further comprising]
 means for feeding said selected medication into said living body from said pump means in a flow which decays exponentially over time.
 380. A programmable infusion system for providing medication to a living body of a patient comprising:
 an infusion apparatus for implantation in said living body, said apparatus including a medication reservoir for storing selected medication,
 means for infusing said selected medication stored in said medication reservoir into said living body, said infusion means having an infusion rate variable upon command,
 command receiver means coupled to said infusion means for receiving command signals,
 means for inhibiting said infusion means from infusing said selected medication if a preselected medication infusion rate is exceeded, said inhibiting means being operably coupled to said infusion means,
 command source means external to said living body for transmitting said command signals to be received by said command receiver means,
 wherein said infusion means comprises a fluid handling mechanism for delivering said selected medication, said operational information including information about the operation of said fluid handling mechanism, wherein said fluid handling mechanism comprises means for pumping said selected medication,
 wherein said pump means comprises variable volume means for storing said selected medication within said pump means, an increase in volume of said variable volume means permitting drawing of said selected

medication into said pump means, decrease in volume of said variable volume means permitting expulsion of said selected medication from said pump means, and [A programmable infusion system in accordance with claim 367, further comprising]

means for telemetering operational information pertaining to said infusion apparatus out of said living body, and means for receiving said telemetered operational information external to said living body, wherein said infusion means further comprises an outlet chamber which is in communication with said living body, said pump means expelling said selected medication into said outlet chamber; and means for monitoring the operation of said pump means, said monitoring means being disposed in said outlet chamber and providing a signal in response to a pressure pulse in said outlet chamber caused by said pump means, said monitoring means being operably coupled to said telemetry means.

384. A programmable infusion system for providing medication to a living body of a patient comprising:
 an infusion apparatus for implantation in said living body, said apparatus including a medication reservoir for storing selected medication,
 means for infusing said selected medication stored in said medication reservoir into said living body, said infusion means having an infusion rate variable upon command,
 command receiver means coupled to said infusion means for receiving command signals,
 means for inhibiting said infusion means from infusing said selected medication if a preselected medication infusion rate is exceeded, said inhibiting means being operably coupled to said infusion means,
 command source means external to said living body for transmitting said command signals to be received by said command receiver means,
 wherein said infusion means comprises a fluid handling mechanism for delivering said selected medication, said operational information including information about the operation of said fluid handling mechanism, wherein said fluid handling mechanism comprises means for pumping said selected medication and [A programmable infusion system in accordance with claim 363, further comprising]
 means for telemetering operational information pertaining to said infusion apparatus out of said living body, means for receiving said telemetered operational information external to said living body, and means for monitoring the operation of said pump means, said monitoring means being operably coupled to said telemetry means.
 388. A programmable infusion system for providing medication to a living body of a patient comprising:
 an infusion apparatus for implantation in said living body, said apparatus including a medication reservoir for storing selected medication,
 means for infusing said selected medication stored in said medication reservoir into said living body, said infusion means having an infusion rate variable upon command,
 command receiver means coupled to said infusion means for receiving command signal,
 means for inhibiting said infusion means from infusing said selected medication if a preselected medication infusion rate is exceeded, said inhibiting means being operably coupled to said infusion means,

command source means external to said living body for transmitting said command signals to be received by said command receiver means, and [A programmable infusion system in accordance with claim 328,] 5
means for generating a distinctive alarm signal pattern for each of a plurality of improper operational conditions.

403. *A programmable infusion system for providing medication to a living body of a patient comprising:*
an infusion apparatus for implantation in said living body, said apparatus including a medication reservoir for storing selected medication,
means for infusing said selected medication stored in said medication reservoir into said living body, said infusion means having an infusion rate variable upon 15
command,
command receiver means coupled to said infusion means for receiving command signals,
means for inhibiting said infusion means from infusing said selected medication if a preselected medication 20
infusion rate is exceeded, said inhibiting means being operably coupled to said infusion means,
command source means external to said living body for transmitting said command signals to be received by said command receiver means, and [A programmable 25
infusion system in accordance with claim 328,]
wherein said infusion means includes means for pumping a preselected amount of medication into said living body, said infusion apparatus further comprising means for recording the rate at which 30
pumping is effected by said pump means.

426. *A programmable infusion system for providing medication to a living body of a patient comprising:*
an infusion apparatus for implantation in said living body, said apparatus including a medication reservoir 35
for storing selected medication,
means for infusing said selected medication stored in said medication reservoir into said living body, said infusion means having an infusion rate variable upon
command, 40
command receiver means coupled to said infusion means for receiving command signals,
means for inhibiting said infusion means from infusing said selected medication if a preselected medication
infusion rate is exceeded, said inhibiting means being 45
operably coupled to said infusion means,

command source means external to said living body for transmitting said command signals to be received by said command receiver means, and
means for maintaining the pressure within said medication reservoir at a pressure level below the internal 50
pressure of said living body,

wherein said pressure maintaining means comprises:
a flexible diaphragm which divides said medication reservoir into a medication chamber and a liquid- 55
vapor pool chamber; and
a liquid vapor pool disposed within said liquid-vapor pool chamber, the proportion of liquid to vapor in said liquid-vapor pool varying in response to variations in the amount of said selected medication 60
disposed in said medication chamber, and [A programmable infusion system in accordance with claim 425, further comprising]

means for telemetering operational information pertaining to said infusion apparatus out of said living 65
body, and means for receiving said telemetered operational information external to said living body, said infusion apparatus further comprising

switch means disposed within said medication reservoir, said switch means being coupled to said telemetry means and being activated when said flexible diaphragm is disposed in a preselected relationship relative to said switch means, said telemetry means telemetering a signal indicative of such an operational condition to said telemetry receiving means.

428. *A programmable infusion system for providing medication to a living body of a patient comprising:*
an infusion apparatus for implantation in said living body, said apparatus including a medication reservoir for storing selected medication,

means for infusing said selected medication stored in said medication reservoir into said living body, said infusion means having an infusion rate variable upon
command,

command receiver means coupled to said infusion means for receiving command signals,

means for inhibiting said infusion means from infusing said selected medication if a preselected medication infusion rate is exceeded, said inhibiting means being operably coupled to said infusion means,

command source means external to said living body for transmitting said command signals to be received by said command receiver means,

means for maintaining the pressure within said medication reservoir at a pressure level below the internal pressure of said living body,

wherein said pressure maintaining means comprises:
flexible diaphragm which divides said medication reservoir into a medication chamber and a liquid-
vapor pool chamber; and

a liquid vapor pool disposed within said liquid-vapor pool chamber, the proportion of liquid to vapor in said liquid-vapor pool varying in response to variations in the amount of said selected medication disposed in said medication chamber, and [A programmable infusion system in accordance with claim 325, said infusion apparatus further comprising] an antechamber through which access is gained to said medication reservoir, and a reservoir inlet valve located between said antechamber and said medication chamber, said reservoir inlet valve being operable when the pressure in said antechamber exceeds the pressure in said medication chamber by more than a predetermined differential.

432. *A programmable infusion system for providing medication to a living body of a patient comprising:*
an infusion apparatus for implantation in said living body, said apparatus including a medication reservoir for storing selected medication,

means for infusing said selected medication stored in said medication reservoir into said living body, said infusion means having an infusion rate variable upon
command,

command receiver means coupled to said infusion means for receiving command signals,

means for inhibiting said infusion means from infusing said selected medication if a preselected medication infusion rate is exceeded, said inhibiting means being operably coupled to said infusion means,

command source means external to said living body for transmitting said command signals to be received by said command receiver means, and [A programmable infusion system in accordance with claim 328, further comprising]

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means for telemetering operational information pertaining to said infusion apparatus out of said living body, means for receiving said telemetered operational information external to said living body, and means for injecting medication into said medication reservoir, said injecting means being coupled to said telemetry receiver means, and programming means coupled to said telemetry means for indicating when injection of medication into said medication reservoir is appropriate.

643. *A programmable infusion system for providing medication to a living body of a patient comprising:*

an infusion apparatus for implantation in said living body, said apparatus including

a medication reservoir for storing selected medication,

means for infusing said selected medication stored in said medication reservoir into said living body, said

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infusion means having an infusion rate variable upon command,

command receiver means coupled to said infusion means for receiving command signals,

means for inhibiting said infusion means from infusing said selected medication if a preselected medication infusion rate is exceeded, said inhibiting means being operably coupled to said infusion means, and

means for telemetering operational information pertaining to said infusion apparatus out of said living body,

command source means external to said living body for transmitting said command signals to be received by said command receiver means, and

means for receiving said telemetered operational information external to said living body.

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**UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION**

PATENT NO. : 4,373,527

Page 1 of 5

DATED : February 15, 1983

INVENTOR(S) : Robert E. Fischell

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Specification:

Col. 1, line 6, delete "filed" and substitute --field--;

Col. 2, lines 60-62, delete "result in body fluids being inadvertently released into the device as opposed to a fatal dose of drug entering the body" and substitute --result in body fluids entering the device as opposed to a fatal dose of drug being inadvertently released into the body--;

Col. 3, line 18-19, delete "values" and substitute --valves--;

Col. 6, line 48, delete "which" and substitute --with--;

In the Claims:

Col. 16, line 19 (Claim 29), delete "value" and substitute --valve--;

Col. 18, lines 23-24 (Claim 47), after "storage" insert --in--;

Col. 26, line 21 (Claim 132), delete "137" and substitute --131--;

Col. 26, line 35 (Claim 134), delete "pushing" and substitute --pulsing--;

Col. 27, line 14 (Claim 140), delete "phase" and substitute --pulse--;

Col. 37, line 8 (Claim 224), delete "lining" and substitute --living--;

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 4,373,527

Page 2 of 5

DATED : February 15, 1983

INVENTOR(S) : Robert E. Fischell

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Col. 39, line 32 (Claim 267), delete "are" and substitute
--is--;

Col. 39, line 48 (Claim 270), after "preselected" insert
--medication--;

Col. 39, line 49 (Claim 270), after "time" insert --of a
predetermined length--;

Col. 43, line 49 (Claim 313), delete "309" and substitute
--299--;

Col. 43, line 68 (Claim 316), delete "315" and substitute
--313--;

Col. 44, line 7 (Claim 318), delete "315" and substitute
--313--;

Col. 44, line 12 (Claim 319), delete "315" and substitute
--313--;

Col. 44, line 30 (Claim 322), delete "accrodance" and
substitute --accordance--;

Col. 48, line 5 (Claim 353), delete "331" and substitute
--351--;

Col. 49, line 11 (Claim 367), delete "364" and substitute
--363--;

Col. 52, line 38 (Claim 399), delete "389" and substitute
--388--;

Col. 55, line 44 (Claim 431), delete "430" and substitute
--328--;

Col. 55, line 48 (Claim 432), delete "430" and substitute
--328--;

Col. 56, line 14 (Claim 435), delete "433" and substitute
--434--;

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 4,373,527

Page 3 of 5

DATED : February 15, 1983

INVENTOR(S) : Robert E. Fischell

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Col. 56, line 20 (Claim 436), delete "433" and substitute
--434--;
Col. 56, line 26 (Claim 437), delete "433" and substitute
--434--;
Col. 56, line 33 (Claim 438), delete "433" and substitute
--434--;
Col. 56, line 38 (Claim 439), delete "433" and substitute
--434--;
Col. 56, line 45 (Claim 440), delete "433" and substitute
--434--;
Col. 58, line 12 (Claim 453), delete "434" and substitute
--433--;
Col. 59, line 2 (Claim 464), delete "463" and substitute
--462--;
Col. 59, line 9 (Claim 466), delete "463" and substitute
--462--;
Col. 59, line 59 (Claim 474), delete "473" and substitute
--469--;
Col. 60, line 24 (Claim 477), delete "464" and substitute
--465--;
Col. 60, line 67 (Claim 483), delete "482" and substitute
--461--;
Col. 66, line 30 (Claim 536), delete "534" and substitute
--433--;
Col. 66, line 34 (Claim 537), delete "534" and substitute
--433--;
Col. 68, line 33 (Claim 555), delete "554" and substitute
--552--;
Col. 68, line 40 (Claim 557), delete "554" and substitute
--552--;

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 4,373,527

Page 4 of 5

DATED : February 15, 1983

INVENTOR(S) : Robert E. Fischell

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Col. 68, line 47 (Claim 558), delete "554" and substitute
--552--;

Col. 69, Line 18 (Claim 562), delete "electric" and
substitute --electronic--;

Col. 70, line 19 (Claim 574), delete "573" and substitute
--572--;

Col. 70, line 28 (Claim 576), after "within said" delete "at
least one,";

Col. 71, line 14 (Claim 585), delete "value" and substitute
--valve--;

Col. 71, line 36 (Claim 586), delete "lining" and substitute
--living--;

Col. 71, line 59 (Claim 589), delete "chambers" and
substitute --chamber--;

Col. 72, line 17 (Claim 593), delete "582" and substitute
--572--;

Col. 73, line 45 (Claim 606), after "predetermined" insert
--length--;

Col. 74, line 47 (Claim 614), delete "613" and substitute
--608--;

Col. 78, line 13 (Claim 642), delete "telemetering" and
substitute --telemetry--;

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 4,373,527

Page 5 of 5

DATED : February 15, 1983

INVENTOR(S) : Robert E. Fischell

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Col. 78, lines 14-15 (Claim 642), delete "telemetering" and substitute --telemetry--.

Signed and Sealed this

Eighth **Day of** *May* 1984

[SEAL]

Attest:

GERALD J. MOSSINGHOFF

Attesting Officer

Commissioner of Patents and Trademarks